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**Environmental Stewardship—
Environmental Characterization and Remediation**

Standard Operating Procedure

For **Sampling of Subatmospheric Air**

☒ **NES Approved**

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Sampling of Subatmospheric Air

Table of Contents

1.0	PURPOSE	4
2.0	SCOPE	4
3.0	TRAINING	4
4.0	DEFINITIONS.....	4
5.0	RESPONSIBLE PERSONNEL	6
6.0	BACKGROUND AND PRECAUTIONS.....	6
7.0	EQUIPMENT	10
8.0	PROCEDURE.....	14
9.0	LESSONS LEARNED.....	21
10.0	RECORDS.....	21
11.0	REFERENCES	22

List of Acronyms and Abbreviations

B&K	Brüel and Krajer
DCC	document control coordinator
DM	document manager
EDS	Education Development System
ENV-ECR	Environmental Stewardship Division–Environmental Characterization and Remediation Group
ENV-ERS	Environmental Stewardship Division–Environmental Remediation and Surveillance Program
FTL	field team leader
FTM	field team member
IWD	Integrated Work Document
LANL	Los Alamos National Laboratory
MSDS	material safety data sheet
PPE	personal protective equipment
PID	photoionization detector
PL	project leader
QII	Quality Improvement and Integration Team
QP	quality procedure
RPF	Records Processing Facility
SMO	Sample Management Office
SOP	standard operating procedure
SSHASP	site-specific health and safety plan
SSO	site-safety officer

Sampling of Subatmospheric Air

1.0 PURPOSE

This standard operating procedure (SOP) states the responsibilities and describes the process of sampling subatmospheric air at Los Alamos National Laboratory (LANL or the Laboratory). This procedure integrates the criteria of the Environmental Stewardship–Environmental Characterization and Remediation (ENV-ECR) Group’s Quality Management Plan.

2.0 SCOPE

All **ENV-ECR participants** shall implement this procedure when sampling subatmospheric air from vapor ports in monitoring wells and boreholes for ENV-ECR Group.

3.0 TRAINING

- 3.1 **Participants** shall train to and use the current version of this SOP. If the text is unclear, contact the author.
- 3.2 **Participants** using this SOP shall document training in accordance with QP-2.2, “Personnel Training Management,” using the training documentation link at the end of this document if they possess a CRYPTOCARD and administrative authority to the Laboratory, Employee Development System (EDS) or using the Training Documentation Form located in the forms section of the ENV-ECR Group web page.
- 3.3 The responsible **project leader (PL)** shall monitor the proper implementation of this procedure.
- 3.4 The responsible **team leader** shall ensure that the appropriate personnel complete all applicable training assignments.
- 3.5 **Participants** may request any needed assistance with implementation of this procedure from the ENV-ECR Group’s Quality Integration and Improvement (QII) team.

4.0 DEFINITIONS

The following definitions are specific to this procedure:

- 4.1 *Absolute pressure*—Pressure measured with reference to absolute zero pressure (as opposed to atmospheric pressure), usually expressed as kPa, mmHg, or psia.

- 4.2 *Adsorbent columns*— Sample containers with an adsorbent material, such as silica gel pellets, that adsorbs water molecules onto its surface. The adsorbed water is analyzed to determine the concentration of the constituents of interest (e.g., subsurface water vapor analyzed for tritium concentrations).
- 4.3 *Brüel and Krajer (B&K) multigas analyzer*—A portable photoacoustic analyzer used to detect and quantify gaseous organic concentration in air.
- 4.4 *Carbon dioxide meter*—A meter used to determine the CO₂ levels of an air sample quickly and efficiently.
- 4.5 *Calibration gas*— Laboratory-certified organic gas mixes, differing in concentrations of organic compounds specific to the field-screening instrument being used.
- 4.6 *Gauge pressure*—A measured pressure greater than ambient atmospheric pressure (as opposed to absolute pressure). Zero gauge pressure is equal to ambient atmospheric (barometric) pressure. Gauge pressure is usually expressed as kPa, mmHg, or psig.
- 4.7 *Packer sample system*—A sampling system using natural rubber inflatable bladders to seal off an interval in an open borehole or at the bottom of a borehole to obtain a sample from a discrete depth interval.
- 4.8 *Photoionization detector (PID)*: A field-screening instrument used to detect volatile organic compounds of interest. This instrument may have different configurations to detect different compounds.
- 4.9 *Sample train*—A multicomponent apparatus consisting of a power source, an inlet line, an outlet line, a valve, a purge pump, and possibly auxiliary meter that provides an interface between the vapor port or packers and connects to the sampling outlets at the surface.
- 4.10 *Site-specific health and safety plan (SSHASP)*—A health and safety plan specific to a site or ENV-ECR Group-related field activity approved by an ENV-ECR Group health and safety representative. This document contains information specific to the project, including the scope of work, relevant history, descriptions of hazards by activity associated with the project site(s), and techniques for exposure mitigation (e.g., personal protective equipment [PPE]) and hazard mitigation.
- 4.11 *Subatmospheric air*—The air that occupies open pore space in soil, sediment, or rock beneath the ground surface.

- 4.12 *SUMMA canister*—A specially treated canister (e.g., evacuated to a negative pressure of approximately 25 mmHg) used as a passive collection and containment system of laboratory-quality air samples.
- 4.13 *Tedlar bag*—A plastic gas-sampling container fitted with an inlet valve used to collect and contain gases. The bag may contain calibration gas for screening instruments.
- 4.14 *Vapor port*—An outlet in the vapor sample tubing. The tubing extends from a specific depth within the borehole, from which the gas sample is taken.

5.0 RESPONSIBLE PERSONNEL

The following personnel are responsible for actions in this procedure:

- author
- field team leader
- field team member
- project leader
- Quality Program project leader
- Environmental Stewardship Division—Environmental Remediation and Surveillance (ENV-ERS) Program and ENV-ECR Group participants (hereafter referred to as “the participants”)
- Site-safety officer

6.0 BACKGROUND AND PRECAUTIONS

All activities described in this section are performed by a **field team member (FTM)**, unless otherwise specified. This procedure must be used in conjunction with an approved site-specific health and safety plan (SSHASP).

6.1 Background

- 6.1.1 This section provides a more detailed description of the function of each component of the system. Each part of the subatmospheric sampling equipment described below has a vital function.
- 6.1.2 The sample train is the primary component of the subatmospheric air-sampling system. It provides an interface between the vapor port and the downhole packer sampling system. Several sampling instruments are necessary for subsurface air sampling.

- 6.1.3 The B&K multigas analyzer quantifies gaseous concentrations of several contaminants in the subsurface air sample.
- 6.1.4 The SUMMA canister captures and contains an air sample for transport to an analytical laboratory.
- 6.1.5 The adsorbent column captures and contains water for tritium analysis by an analytical laboratory.
- 6.2 Sample Train
 - 6.2.1 The sample train interfaces the purge pump and the sampling equipment with the sample interval in the borehole.
 - 6.2.2 The sample train has two distinct operations: the purge cycle and the sampling cycle.
 - 6.2.3 Before each sampling cycle, vapor sample tubing must be purged of stagnant air in the line by drawing air from the sample interval through the line.
 - 6.2.4 Purging the line ensures that the sample collected is representative of the subsurface air at depth; every sampling activity must include a purge cycle.
 - 6.2.5 After the line is purged, the sample train is available to interface with the sampling equipment.
- 6.3 B&K Sampling
 - 6.3.1 The B&K multigas analyzer screens air for organic gaseous concentrations and water vapor. Six factory-installed optical filters in the B&K determine which substances may be analyzed.
 - 6.3.2 The gases TCA, TCE, Freon-11, PCE, and CO₂ and water vapor in the air sample are analyzed.
 - 6.3.3 The instrument quantifies and displays the concentrations of the gases and water vapor. Data displayed on the B&K are in ppm.
 - 6.3.4 Before daily sampling activities, the B&K must be tested for operational efficiency by an operational check.
- 6.4 SUMMA Sampling
 - 6.4.1 The SUMMA canister is an evacuated vessel used for collecting and containing analytical quality air samples.
 - 6.4.2 The low pressure in the canister pulls air inside until a neutral pressure has been achieved.

- 6.4.3 To preserve the integrity of the air for analysis, the manufacturer certifies that the canisters are contaminant-free and the inside of the canister is nonreactive.

6.5 Adsorbent Column Sampling

- 6.5.1 Soil pore-space water vapor can be easily collected and contained for analysis when using silica as an adsorbent.
- 6.5.2 Water vapor is adsorbed onto the silica when subsurface air is pulled through the column.
- 6.5.3 After a sample of subsurface water vapor has been collected, the column is removed from the system and is sealed, providing both a collection and containment vessel.
- 6.5.4 The sealed columns then may be sent to an analytical laboratory for analysis.

6.6 Packer Sampling System

- 6.6.1 The packer sampling system may be used in an open borehole or at the bottom of a borehole when no vapor ports are available to connect to the sample train.
- 6.6.2 An inflatable packer seals off an area in which a vapor sample is desired and then is connected to the sample train.

6.7 Precautions and Safety Issues

All activities described in this section are performed by a **FTM**, unless otherwise specified.

- 6.7.1 Properly documented field procedures must be followed to ensure that wells and boreholes do not become damaged or contaminated during sampling activities.
- 6.7.2 Waste generated from sampling activities must be handled in accordance with SOP-1.06, "Management of ER Project Wastes."
- 6.7.3 Personnel safety procedures, such as safety practices and site-specific requirements determined by the **site-safety officer (SSO)** and the SSHASP, shall be observed to prevent exposure to hazardous materials and physical hazards.
- 6.7.4 This procedure requires the use of compressed-gas cylinders, pumps, and field-screening instruments. Instructions to ensure that safe handling of compressed air systems are included in the Integrated Work Document (IWD).

- 6.7.5 All equipment and materials must be handled in a safe manner consistent with the limitations stated by the manufacturer.
- 6.7.6 All warning labels associated with the equipment must be read carefully.
- 6.7.7 A material safety data sheet (MSDS) must be obtained from the SSO or manufacturer for all compressed gases and reagents.
- 6.7.8 The **field team leader (FTL)** shall ensure all FTM have reviewed the MSDS of each gas or reagent before starting sampling operations.
- 6.7.9 Vapor ports extend from the borehole cover and are connected to tubing that descend down the borehole. The vapor ports must be handled with care.
- 6.7.10 Because of the harsh conditions in the field, the plastic tubing of the sampling lines and vapor ports may degrade over time, depth tags on the tubing or ports may become unreadable, or plugs may be lost. Any unusual conditions of the sampling lines (tubing) or vapor ports must be documented in the field logbook.
- 6.7.11 Special care should be taken during the installation of the adsorbent columns into the sample train to minimize exposure to ambient air and to properly orient the column so the air stream flows in the correct direction through the column during sampling.
- 6.7.12 Radon contamination may be present on some of the sampling lines or vapor ports. Invariably radon will collect on the sampling lines or vapor ports because the plastic has a slightly negative static charge.
- 6.7.13 When connecting the tubing or ports to the sample train, the FTM may receive a radon dose, particularly from tubing or vapor ports at ground level.
- 6.7.14 The human body has a slight positive charge, and the hands may attract minute amounts of radon when they come in contact with the vapor ports or plastic tubing. Clapping the hands to eliminate any built-up static charge may alleviate this problem. Nitrile gloves should be worn for protection, and they may also alleviate the problem of static charge.

- 6.7.15 Before the packer system is lowered into an open borehole, the borehole must be checked for any irregularities. This check may be done using a downhole camera system.

7.0 EQUIPMENT

This section describes of the function of the field-sampling equipment.

- 7.1 The responsible **PL** shall prepare an equipment and supply checklist, if applicable, for use during implementation of this procedure.
- 7.2 **Participants** shall use only the equipment and supplies authorized by the responsible PL.
- 7.3 **Participants** shall report to the PL any equipment or supply item listed below that is not available for use and the need for equipment or supply items in addition to, or different from, the equipment and supplies listed below.

7.3.1 Sample Train

- 7.3.1.1 The sample train consists of a power source, an inlet line, an outlet line, a valve, a purge pump, and possible auxiliary meters (e.g., CO₂ or flow).
- 7.3.1.2 The vapor screening/sampling operation requires a power source, such as a portable gasoline generator.
- 7.3.1.3 The inlet line interfaces with the vapor ports by plugging into and onto the ports.
- 7.3.1.4 The outlet line sends air to the sampling equipment.
- 7.3.1.5 The valve switches the inlet line between the purge pump and the outlet line.
- 7.3.1.6 The purge pump pulls subsurface air into the CO₂ meter.
- 7.3.1.7 The meter displays the CO₂ levels of the subsurface air.
- 7.3.1.8 When CO₂ levels stabilize, the subsurface air in the line is sampled.
- 7.3.1.9 Most sampling devices may be used for subsurface air sampling using the sample train.
- 7.3.1.10 The sample train is a delicate device. The tubing can kink and contaminate the samples. The tubing must also be free of dirt and debris that may foul or plug the inlet/outlet lines.

- 7.3.1.11 Once sampling is complete, the lines must be purged for 10 to 15 min to remove contaminants in the system.
 - 7.3.1.12 To ensure valid results, nonmetal tubing must be replaced between sampling events. Replacement of the tubing must be documented in the field logbook.
 - 7.3.1.13 If tubing was not replaced after the previous sampling event, it must be replaced and the replacement documented in the field logbook before quarterly sampling activities begin.
- 7.3.2 B&K Photoacoustic Multigas Analyzer
- 7.3.2.1 The B&K analyzer quantifies gaseous concentration of five constituent gases and water vapor in air samples.
 - 7.3.2.2 The analysis cycle lasts approximately two minutes and consists of an internal purge, a sampling event, an analysis event, and finally a display.
 - 7.3.2.3 The internal purge expels all the previous sample air from the analysis chamber.
 - 7.3.2.4 The sampling event draws a new air sample into the analysis chamber.
 - 7.3.2.5 The analysis event is the photoacoustic interaction between the air and the infrared light in the analysis chamber.
 - 7.3.2.6 The analysis chamber is a vessel that houses an optical filter and a microphone.
 - 7.3.2.7 The filter allows infrared light to pass into the air sample.
 - 7.3.2.8 The microphones listen for the photoacoustic interaction.
 - 7.3.2.9 The internal computer quantifies the analysis, and the instrument shows the results.
 - 7.3.2.10 An operational check must be conducted before a field-screening event begins to verify that the B&K analyzer is functioning properly.
 - 7.3.2.11 The B&K must be adjusted to ambient pressure and temperature periodically throughout the day.

The following conditions or events may hinder the performance of the B&K analyzer and should be avoided:

- The B&K is temperature sensitive and must be protected from thermal trauma.
- The microphones make the B&K shock-sensitive; hence, the instrument must avoid intense physical trauma.
- The B&K tubing must remain free of debris and dirt that can foul the internal pumps and the internal air filters.

7.3.3 SUMMA Canisters

- 7.3.3.1 The stainless steel SUMMA sample canister is evacuated to a negative pressure of approximately 25 mmHg. The passivation process of the stainless steel canister ensures it will not react with constituents in the sample.
- 7.3.3.2 The low pressure of the canister also eliminates the need for a pump to draw the sample.
- 7.3.3.3 The stainless steel design and evacuation are a simple, efficient method for providing an analytical-quality subsurface air sample.
- 7.3.3.4 The connection of the SUMMA canister to the sample train must not be compromised. A pressure valve and vacuum gauge help ensure the system has no leaks.
- 7.3.3.5 The pressure valve and vacuum gauge also regulate the rate and duration of air collection into the canister.
- 7.3.3.6 The vacuum gauge aids in determining if leaks are present in the pressure valve, a well port is blocked, or the SUMMA is full.
- 7.3.3.7 To ensure sample quality, SUMMA canisters must be certified by the contract laboratory as clean and free of leaks.
- 7.3.3.8 Certified clean canisters must be obtained through the Sample Management Office (SMO) from the contract laboratory where the samples will be analyzed.

7.3.4 Absorbent Columns

- 7.3.4.1 The adsorbent columns are cylinder containers filled with silica and open at each end.
- 7.3.4.2 A pump pulls air through the silica. Water vapor from the subatmospheric air adsorbs onto the silica surface.
- 7.3.4.3 After more than 5 mL (5 g) of water have been collected, the column is sealed at each end. The column provides both a collection and containment vessel.
- 7.3.4.4 Once it is placed in the column, the silica must not be exposed to ambient air. Excessive exposure to ambient air may allow ambient water vapor to collect, thus compromising the adsorbent column sampling.

A silica temperature exceeding the temperature of the air being sampled reduces the efficiency of the silica to adsorb water. Therefore, when subsurface air is sampled, the temperature of the silica shall be maintained at or below 12°C (the average temperature of subsurface air) by keeping the column in a cooler with blue ice.
- 7.3.4.5 The ends of the columns must be sealed immediately after sample collection is complete.
- 7.3.4.6 The mass of the column is vital for analysis.
- 7.3.4.7 The mass of the column must be measured before field activities begin or immediately before sampling. The mass of the column plugs must be monitored as well. A sufficient volume is collected when the mass is increased by more than 5 g.

7.3.5 Subsurface Vapor Ports

- 7.3.5.1 Subsurface vapor ports extend from boreholes completed with sampling membranes or alternating fill of sand and bentonite.
- 7.3.5.2 Location identification numbers are typically stamped or displayed on the lid.
- 7.3.5.3 The ports protrude from the top of the borehole cap to connect to the sample train and are labeled to identify the port depth.

7.3.6 Packer Sampling System

- 7.3.6.1 The packer system consists of a reel with measured and marked air lines and electrical wires that connect the downhole packers with the surface controls.
- 7.3.6.2 A laptop computer is used to control the downhole instrument package when manual controls are not used.
- 7.3.6.3 A generator is used to supply power when needed.
- 7.3.6.4 An air compressor or commercially available compressed gas, such as nitrogen, is used to inflate the packers.
- 7.3.6.5 Many different sizes of packers are available for boreholes of different sizes.
- 7.3.6.6 The system also has a sample line made of a material that will not cause cross-contamination in the sampling process.
- 7.3.6.7 The packer system is used in an open borehole to sample a discrete interval by sealing off above and below the sampling interval with the inflatable packers.

8.0 PROCEDURE

ER Project personnel may produce paper copies of this procedure printed from the controlled-document electronic file located at http://erinternal.lanl.gov/home_links/Library_proc.htm. However, it is each person's responsibility to ensure that they trained to and utilize the current version of this procedure. The author may be contacted if text is unclear. The Document Control Coordinator may be contacted if the author cannot be located.

Deviations from SOPs are made in accordance with QP-4.2, "Standard Operating Procedure Development" and documented in accordance with QP-5.7, "Notebook Documentation for Environmental Restoration Technical Activities."

8.1 Documenting Field Activities

The **FTL** shall ensure the documentation of all field logbook entries in accordance with QP-5.7.

8.2 Presampling Activities

(Note: when this SOP was first revised, the B&K vapor analyzer was specifically referred to as the field-screening instrument. In the following descriptions, the use of any field-screening instrument [i.e., a PID] requires following manufacturers' operation and instruction manuals.) See SOP 06.33, "Head Space Vapor Screening with a Photoionization Detector."

The **FTM** shall perform the following presampling activities:

- 8.2.1 Identify appropriate sampling techniques to be used (i.e., B&K samples to determine the extent of contamination of chlorinated organic vapor in the subsurface air, SUMMA canisters to collect laboratory-quality air samples for shipping, or adsorbent columns to sample subsurface water vapor in subsurface air).
- 8.2.2 Inspect all tubing, fittings, and valves on the sample train.
- 8.2.3 Inspect Swagelok fittings for degradation.
- 8.2.4 Tighten, as necessary, all fittings and valves that make up the assembly.
- 8.2.5 Ensure that the power supply is functional.
- 8.2.6 Perform B&K operational check, if needed. (The purpose of the operational check is to introduce a laboratory-certified organic gas mixture to the B&K to check the unit for proper operation.)
- 8.2.7 Sample three mixes of the Laboratory-certified calibration gas using the B&K.
- 8.2.8 If the B&K reports a concentration equal to or better than 80% of the laboratory-certified concentration, the B&K functioning properly.
- 8.2.9 If the B&K operational check does not quantify the results of the analysis within 80% of the laboratory-certified concentrations, several actions may be taken to improve performance, such as
 - changing the setup parameter (refer to B&K 1305 operational manual for instructions);
 - inspecting the Tedlar bags (the bags may degrade and fail over time and leak); or
 - calling the manufacturer (California Instruments) at (714) 974-5560.

- 8.2.10 Before operating the B&K unit, read the operational instruction manual of the B&K 1305 unit.
- 8.2.11 Adjust setup conditions of the B&K to ambient pressure and temperature.
- 8.2.12 Refer to the B&K 1305 operational manual for definitions of error messages.
- 8.2.13 Ensure that the following equipment is available:
- B&K unit
 - CGA 590 bolt compressed gas regulator
 - three Tedlar bags
 - a large adjustable wrench
 - a length of 1/4-in. Teflon tubing
 - 1/4-in. Swagelok fittings (bolts, ferrules, collets)
 - calibration gas representative of the expected compounds and concentration ranges
- 8.2.14 Inspect the on/off switch, the functional buttons, power cord, the inlet line, and the outlet line.
- 8.2.15 Ensure the B&K has a functional power source.
- 8.2.16 Fill the Tedlar bags as the first step in the operational check.
- Note:** The Tedlar bags must be filled with gases that are contained in pressurized tanks and must be handled very carefully.
- 8.2.16.1 Identify the concentration of the calibration gas.
- 8.2.16.2 Confirm that the calibration gas concentration and the Tedlar bag calibration gas concentration label agree.
- 8.2.16.3 Use each bag only for a specific gas mix.
- 8.2.16.4 Ensure that the regulator valve is closed.
- 8.2.16.5 Connect the regulator to the calibration gas bottle and connect the Tedlar bag to the regulator.
- 8.2.16.6 Open the valve on the Tedlar bag and the valve on the bottle.

- 8.2.16.7 Slowly open the regulator valve and fill the Tedlar bag. Close the regulator valve, the Tedlar bag valve, and then the bottle valve.
- 8.2.16.8 Remove the Tedlar bag from the regulator.
- 8.2.16.9 Open and close the regulator valve to release any gas in the regulator.
- 8.2.16.10 Remove the regulator from the gas bottle.
- 8.2.16.11 Perform the B&K calibration (the second step in the operational check).
- 8.2.17 The second step in the operational check, the calibration check, is performed as follows.
 - 8.2.17.1 Turn on the B&K.
 - 8.2.17.2 Connect a Tedlar bag to the B&K inlet line.
 - 8.2.17.3 Open the Tedlar bag valve.
 - 8.2.17.4 Begin continuous monitoring of the B&K. Refer to the B&K manual for operation instructions.
 - 8.2.17.5 Allow the B&K to take several samples of gas from the Tedlar bag.
 - 8.2.17.6 Observe the B&K gas concentration display. The goal is to achieve concentration values equal to or greater than 80% of the laboratory-certified concentrations of the calibration gas mix.
 - 8.2.17.7 Document the operational check results in the field logbook.
 - 8.2.17.8 Close the Tedlar bag valve and remove it from the inlet line.
- 8.2.18 Document the following presampling activities into the field logbook:
 - sample train inspection
 - calibration
 - port conditions
 - tubing problems/solutions
 - B&K operational check

- 8.2.19 If a packer system is used for sampling, check the inflatable packers and air line fittings for leaks before it is sent downhole.

8.3 Sampling Activities

The **FTM** shall perform the following sampling activities:

- 8.3.1 Confirm borehole number and location.
- 8.3.2 Document the start of sampling activities in field logbook.
- 8.3.3 Identify and correlate the borehole number with field logbook borehole number.
- 8.3.4 Inspect the vapor port.
- 8.3.5 Document any abnormal conditions of the vapor port in the field logbook.
- 8.3.6 Purge the sample train for approximately 10 to 15 min with the purge pump to remove all stagnant air within the tubing and valves.
- 8.3.7 Connect the sample train inlet line to the vapor port.
- 8.3.8 Begin one of the specific sampling activities below.

8.4 B&K Sampling

The **FTM** shall perform the following B&K sampling activities:

- 8.4.1 Disconnect the B&K inlet line from the sample train.
- 8.4.2 Ensure that the B&K is in *Continuous Monitoring* mode.
- 8.4.3 Press the *Standby* button on B&K control display to start the sampling cycle.
- 8.4.4 Allow the B&K to take three ambient-air readings and record the gas concentrations for each in the field logbook.
- 8.4.5 Press the *Standby* button to stop the sampling cycle.
- 8.4.6 Connect the B&K inlet line to the B&K outlet of the sample train.
- 8.4.7 Ensure that the sample train valve is on *Purge*.
- 8.4.8 Ensure that the CO₂ meter inlet line is connected to the purge pump outlet line and is operating.
- 8.4.9 Activate the purge pump and purge the vapor sampling line to depth.

- 8.4.10 Observe the CO₂ measurement carefully while purging the line.
- 8.4.11 When the CO₂ level stabilizes, read and record the measurement into the field logbook.
- 8.4.12 Deactivate the pump and quickly turn the sample train valve from *Purge* to *B&K*.
- 8.4.13 Press the *Standby* button on the B&K control panel to start the sampling cycle.
- 8.4.14 Record the measurement of the B&K analysis and the current date and time in the field logbook.
- 8.4.15 Press the *Standby* button to stop the sampling.
- 8.4.16 Disconnect the sample train inlet line from vapor port.

8.5 SUMMA Sampling

The **FTM** shall perform the following SUMMA sampling activities:

- 8.5.1 Ensure that action steps 8.4.1 through 8.4.6 are completed.
- 8.5.2 Activate the purge pump and purge the vapor sampling line to depth.
- 8.5.3 Observe the CO₂ measurement carefully while purging the line.
- 8.5.4 When the CO₂ level stabilizes, record the measurement in the field logbook.
- 8.5.5 Disconnect the sample train from the vapor port.
- 8.5.6 Connect pressure valve with the vacuum gauge to the vapor port; ensure that all the valves are closed.
- 8.5.7 Attach the SUMMA canister to the pressure valve.
- 8.5.8 Open the valve on the SUMMA canister and check the vacuum gauge for proper vacuum.
- 8.5.9 Open the pressure valve; the SUMMA canister will draw an air sample because of the vacuum in the canister.
- 8.5.10 Close the valve on the canister when the gauge indicates the pressures in the canister and atmospheric pressure have equilibrated.
- 8.5.11 Complete the identification tag of the canister.
- 8.5.12 Document SUMMA sampling in the field logbook, in the sample collection log, and on the chain-of-custody forms.

- 8.5.13 Disconnect pressure valve from vapor port.
- 8.5.14 Store the canister in the shipping container and ship to the Laboratory SMO, according to SOP 01.03, "Handling, Packaging, and Shipping of Samples."

8.6 Adsorbent Column Sampling

The **FTM** shall perform the following adsorbent column sampling activities:

- 8.6.1 Ensure that action steps 8.4.1 through 8.4.6 are completed.
- 8.6.2 Measure the mass of the adsorbent columns before field activities start and record the data in the field logbook.
- 8.6.3 Activate purge pump and purge the vapor sampling line to depth; observe the CO₂ measurement carefully while purging the line.
- 8.6.4 When the CO₂ level stabilizes, record the measurement in the field logbook.
- 8.6.5 Connect the adsorbent column to the exhaust of the sample train.
- 8.6.6 Activate pump to pull air through the adsorbent column until the mass of the column is increased by at least 5 g.
- 8.6.7 Quickly remove column and seal the ends.
- 8.6.8 Document the adsorbent column sample in the field logbook, in the sample collection log, and on the chain-of-custody forms.
- 8.6.9 Submit samples to the Laboratory's SMO in accordance with SOP-01.03, "Handling, Packaging and Shipping of Samples."

8.7 Sampling through the Packer System

The **FTM** shall perform the following sampling through the packer system activities:

- 8.7.1 Connect the proper size packer along with the desired separation between packers (if using two packers) and record the information in logbook.
- 8.7.2 Lower the packer(s) to desired depth; record the information in logbook.
- 8.7.3 Inflate the packer(s) to desired pressure.

8.7.4 Record the pressure in the logbook and continue to monitor the pressure throughout the sampling process.

Note: The packer pressure should remain above 1 psi. If the pressure drops below 1 psi, reinflate the packer(s). Low pressure indicates the sample zone may not be isolated.

8.7.5 Connect the sample line to the sample train and continue from action step 8.3.3.

8.7.6 Deflate the packer(s) before pulling them out of the borehole.

8.8 Post sampling Activities

The **FTM** shall perform the following post sampling activities:

8.8.1 Dispose of any tubing that is visibly damaged or contaminated.

8.8.2 Purge indicator gas concentrations (i.e., CO₂) should remain constant if the sample stream is free of leaks and a proper purge is achieved.

8.8.3 Ensure the quality of the sample by eliminating any leaks in the system.

8.8.4 Whenever two or more gas lines are connected, confirm the connection is free of visible and audible leaks.

8.8.5 Whenever data quality is questionable or possibly compromised, inspect all connections for leaks.

9.0 LESSONS LEARNED

9.1 Before performing work described in this SOP, **participants** should go to the Department of Energy Lessons Learned Information Services home page, located at <http://www.tis.eh.doe.gov/II/II.html> and/or to the LANL Lessons Learned Resources web page, located at http://www.lanl.gov/projects/lessons_learned/, and search for applicable lessons.

9.2 During work performance and/or after the completion of work activities, **participants**, as appropriate, shall identify, document, and submit lessons learned in accordance with the LANL Lessons Learned System, located at http://www.lanl.gov/projects/lessons_learned/.

10.0 RECORDS

The **FTL** shall submit the following records to the Records Processing Facility, in accordance with QP-4.4, "Record Transmittal to the Records Processing Facility":

- completed the chain-of-custody/request for analysis forms
- closed out the field logbooks
- completed sample the collection logs

11.0 REFERENCES

To implement this procedure properly, **participants** should become familiar with the contents of the following documents, available at http://erinternal.lanl.gov/home_links/Library_proc.shtml:

- The ENV-ECR “Quality Management Plan”
- QP-2.2, “Personnel Training Management Process”
- QP-4.4, “Record Transmittal to the Records Processing Facility”
- QP-5.7, “Notebook Documentation for Environmental Restoration Technical Activities”
- SOP-01.01, “General Instructions for Field Investigations”
- SOP-01.03, “Handling, Packaging and Shipping of Samples”
- SOP-06.03, “Head Space Vapor Screening with a Photoionization Detector”

[Using a token card, click \(+control key\) here to record "self-study" training to this procedure.](#)

If you do not possess a token card or encounter problems, contact the ENV-ECR training specialist.